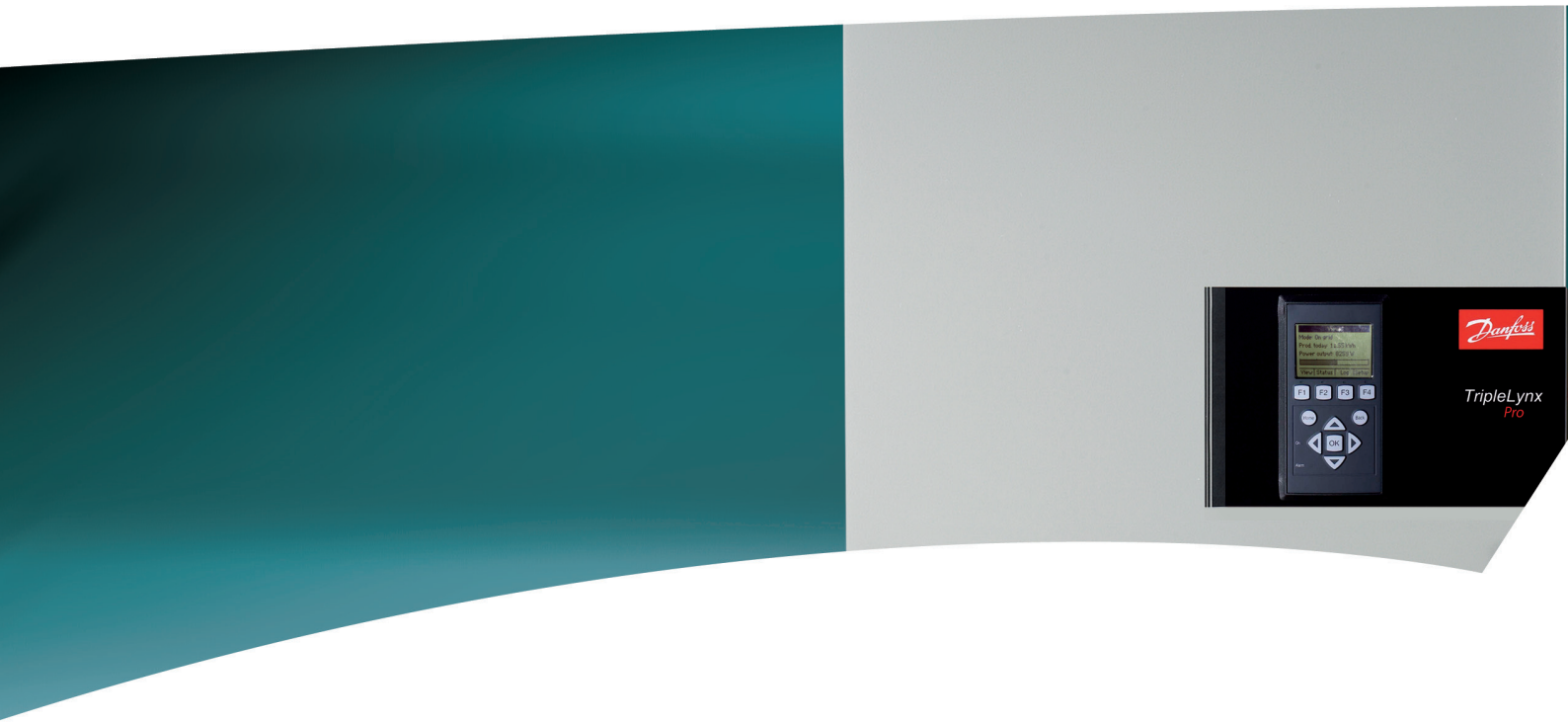
MAKING MODERN LIVING POSSIBLE



TLX
Installation Manual

Three-phase – 6k, 8k, 10k, 12.5k and 15k

SOLAR INVERTERS

Safety and Conformity

Safety

All persons installing and servicing inverters must be:

- Trained and experienced in general safety rules for work on electrical equipment
- Familiar with local requirements, rules and regulations for the installation

Safety Message Types

⚠WARNING

Safety information important for human safety. Warnings are used for indicating potentially hazardous situations that can cause serious injury or death.

⚠CAUTION

Cautions with symbol are used for indicating potentially hazardous situations that can cause minor or moderate injuries.

CAUTION

Cautions without symbol are used for indicating situations that may result in equipment or property damage.

NOTE

Note is used for indicating highlighted information that should be regarded with attention.

General Safety

NOTE

Before installation
Check for damage to inverter and packaging. If in doubt, contact the supplier before installing the inverter.

CAUTION

Installation
For optimum safety, follow the steps described in this manual. Keep in mind that the inverter has two voltage carrying sides; the PV input and the AC grid.

⚠WARNING

Disconnecting the inverter
Before starting work on the inverter, switch off AC grid at the mains switch and PV using the PV load switch. Ensure that the device cannot be unintentionally reconnected. Use a voltage tester to ensure that the unit is disconnected and voltage free. The inverter can still be charged with very high voltage at hazardous levels even when it is disconnected from grid/mains and solar modules. Wait at least 30 min. following disconnection from grid and PV panels before proceeding.

⚠CAUTION

Maintenance and modification
Only authorised personnel are allowed to repair or modify the inverter. To ensure personal safety, only original spare parts available from the supplier should be used. If non-original spare parts are used, the compliance with CE guidelines in respect of electrical safety, EMC and machine safety is not guaranteed.
The temperature of the cooling racks and components inside the inverter may exceed 70ºC. Observe the danger of burn injury.

⚠CAUTION

Functional safety parameters
Never change the parameters of the inverter without authorisation from the local energy supply company and instructions from Danfoss.
Unauthorised changes of functional safety parameters may cause injury or accidents to people or inverter.
Additionally, it will lead to the cancellation of all inverter operating approval certificates and Danfoss warranties. Danfoss cannot be held responsible for such injuries or accidents.

Hazards of PV Systems

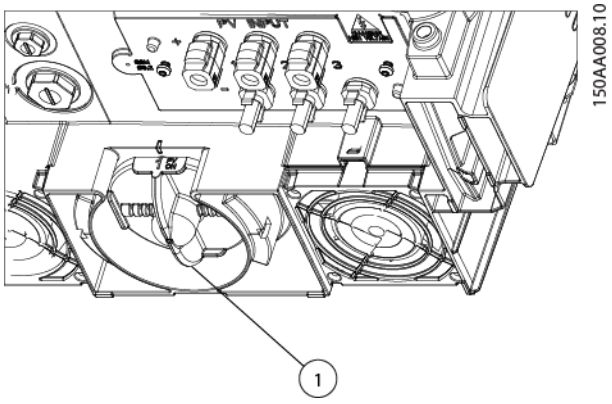
DC voltages up to 1000 V are present in a PV system even when the AC grid is disconnected. Faults or inappropriate use may lead to electric arcing.

⚠WARNING

Do not work on the inverter while disconnecting DC and AC.

The short-circuit current of the photovoltaic panels is only slightly higher than the maximum operating current and depends on the level of solar irradiation.

PV Load Switch



The PV load switch (1) enables safe disconnection of DC current.

Conformity

Go to the download area at www.danfoss.com/solar, Approvals and Certifications, for information.

CE	CE marking - This certifies the conformity of the equipment with the regulations which apply in accordance with the directives 2004/108/EC and 2006/95/EC.

Table 1.1

Contents

1 Introduction 2

1.1.1 Installation Sequence 3

1.1.2 Overview of Inverter 4

2 Installation 5

2.1 Installation Dimensions and Patterns 5

2.2 Mounting the Inverter 8

2.3 Removing the Inverter 9

2.4 Opening and Closing the Inverter 9

2.5 AC Grid Connection 11

2.6 Parallel PV String Configuration 12

2.7 PV Connection 14

2.8 Auxiliary Input/Output 14

2.9 Autotest Procedure 14

3 Start-up and Check of Settings 15

3.1.1 Initial Setup 15

3.2 Troubleshooting 17

3.3 Master Mode 17

4 Technical Data 18

4.1 General Data 18

4.2 Norms and Standards 20

4.3 France UTE Requirements 21

4.4 Installation 21

4.5 Cable Requirements 22

4.6 Torque Specifications for Installation 25

4.7 Mains Circuit Specifications 26

4.8 Auxiliary Interface Specifications 27

4.9 RS-485 and Ethernet Connections 29

1 Introduction

1

Illustration 1.1 Solar Inverter

This manual explains the installation and setup of the TLX Series solar inverter, for the installation technician.

The TLX Series inverter range comprises the variants:
TLX
TLX+
TLX Pro
TLX Pro+

	TLX	TLX+	TLX Pro	TLX Pro+
Common features				
Power	6 kVA - 15 kVA			
Enclosure	IP54			
PV connectors	MC4 connectors			
User interface	Display			
	Service web interface		Web interface	
Languages	DK, GB, DE, FR, ES, ITA, CZ, NL, GR			

Table 1.1 Common Features

Product Label

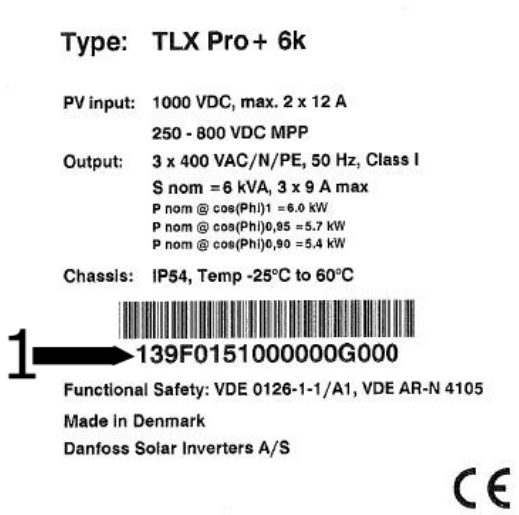

Type: TLX Pro+ 6k
PV input: 1000 VDC, max. 2 x 12 A
250 - 800 VDC MPP
Output: 3 x 400 VAC/N/PE, 50 Hz, Class I
S nom =6 kVA, 3 x 9 A max
P nom @ cos(Phi)1 =6.0 kW
P nom @ cos(Phi)0,95 =5.7 kW
P nom @ cos(Phi)0,90 =5.4 kW
Chassis: IP54, Temp -25°C to 60°C
1
139F0151000000G000
Functional Safety: VDE 0126-1-1/A1, VDE AR-N 4105
Made in Denmark
Danfoss Solar Inverters A/S
CE

Illustration 1.2 Product Label

The product label on the side of the inverter shows:

- Inverter type
- Important specifications
- Serial number, see (1), for identification by Danfoss

1.1.1 Installation Sequence

1. Pay special attention to *1 Safety and Conformity*.
2. Install the inverter according to *2.1 Installation Dimensions and Patterns* and *2.2 Mounting the Inverter*.
3. Open the inverter according to *2.4 Opening and Closing the Inverter*.
4. Install AC according to *2.5 AC Grid Connection*.
5. Install PV.
6. Install Auxiliary input according to *2.8 Auxiliary Input/Output* .
7. Close the inverter according to *2.4 Opening and Closing the Inverter*.
8. Turn on AC at the mains switch.
9. Set language, time, date, installed PV power, country and grid:
   - For setup via the web interface, see the *TLX Series User Manual*, *Web Server Quick Guide* section.
   - For setup via the display, see *3 Start-up and Check of Settings*.
10. Turn on PV by turning the PV load switch on.
11. Verify the installation by comparing with the auto-detection result in the display, as described in *2.7 PV Connection*.
12. The inverter is now ready for operation.

1

1.1.2 Overview of Inverter

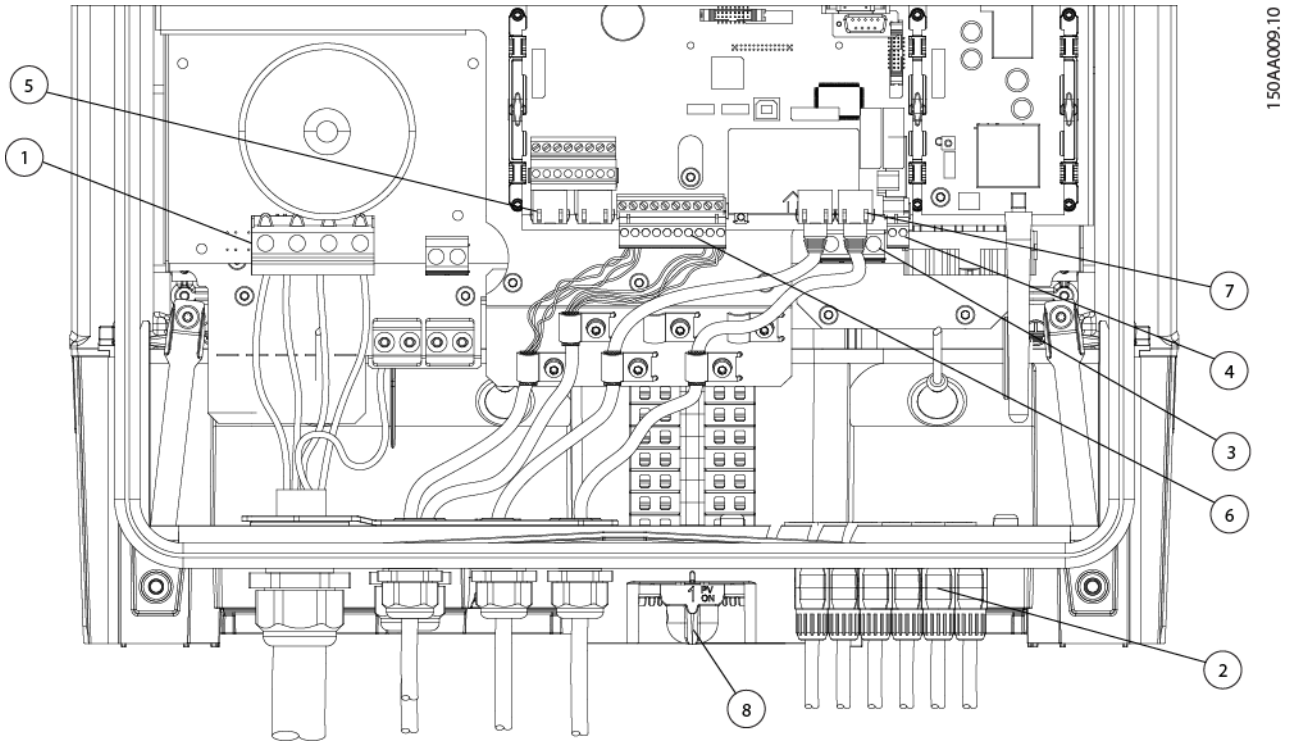


Illustration 1.3 Overview of Danfoss TLX inverter

Live Parts

1. AC Connection Area
2. DC Connection Area
3. Terminal block for parallel connection
4. Auxiliary output: Potential free relay
5. Auxiliary interface: RS-485
6. Auxiliary interface: Temperature, Irradiation, Energy meter (SO)
7. Auxiliary interface: Ethernet

Other

8. PV load switch

PELV (Safe to touch)

The TLX Pro and TLX Pro+ variants can also be configured via the web interface. For further information refer to the Web Server User Manual.

2 Installation

2.1 Installation Dimensions and Patterns

CAUTION

Follow these instructions carefully to ensure correct installation of the inverter.

NOTE

When choosing the installation place, ensure that all labels are visible at all times. For details refer to *4 Technical Data*.

Illustration 2.1 Avoid constant stream of water

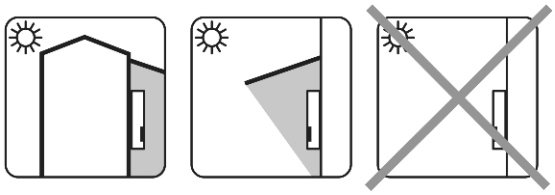


Illustration 2.2 Avoid direct sunlight

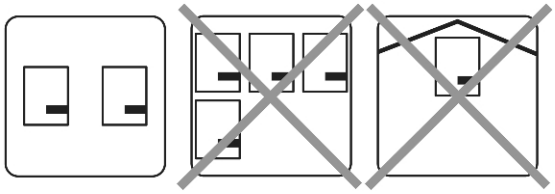


Illustration 2.3 Ensure adequate air flow

Illustration 2.4 Ensure adequate air flow

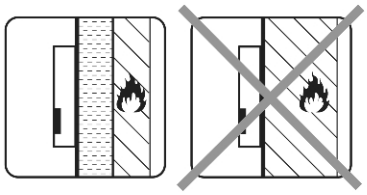


Illustration 2.5 Mount on non-flammable surface

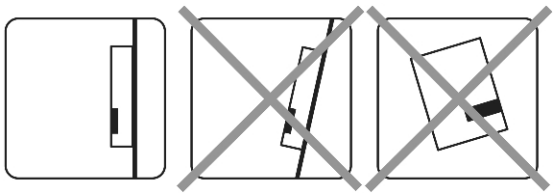


Illustration 2.6 Mount upright on vertical surface

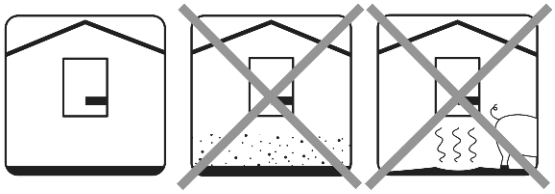


Illustration 2.7 Prevent dust and ammonia gases

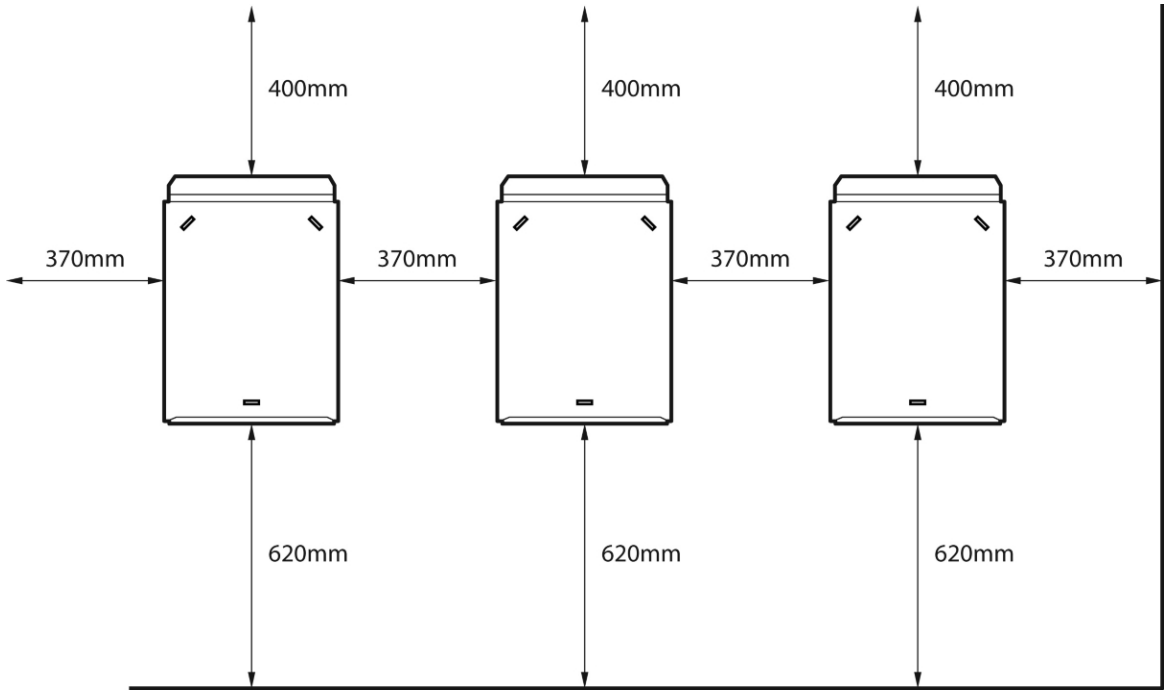


Illustration 2.8 Safe Distances

Observe these distances when installing one or more inverters. One-row mounting is recommended. Contact the supplier for information on mounting in more rows.

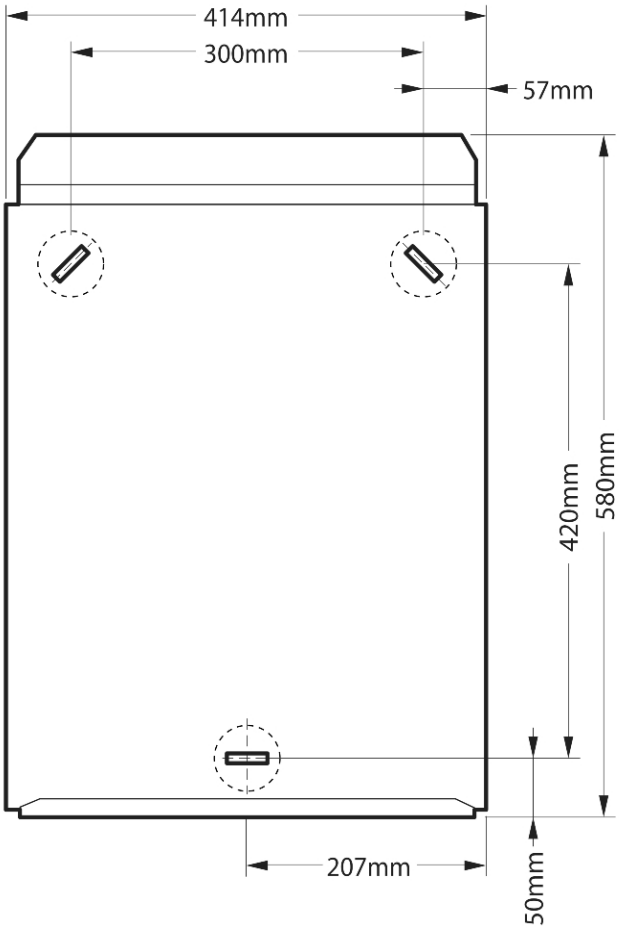


Illustration 2.9 Wall Plate

NOTE

Use of the wall plate delivered with the inverter is mandatory.

Use screws that can safely carry the weight of the inverter. The inverter must be aligned and it is important that the inverter is accessible at the front to allow room for servicing.

2

2.2 Mounting the Inverter

⚠CAUTION

For safe handling of the inverter, two people must carry the unit, or a suitable transport trolley must be used. Safety boots must be worn.

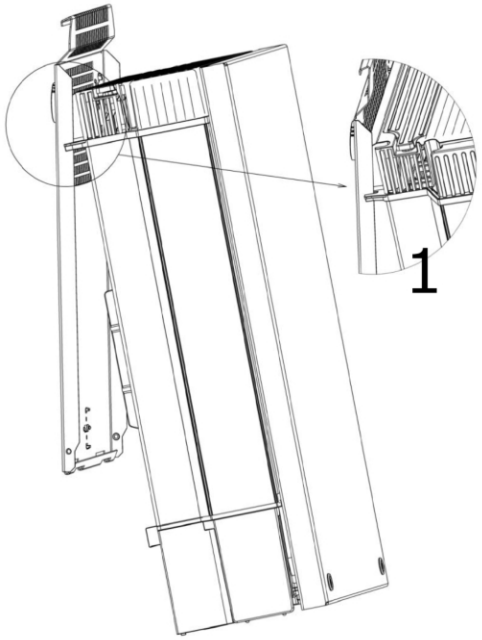


Illustration 2.10 Position the Inverter

Tilt the inverter as shown in the illustration and place the top of the inverter against the mounting bracket. Use the two guides (1) at the top plate to control the inverter horizontally.

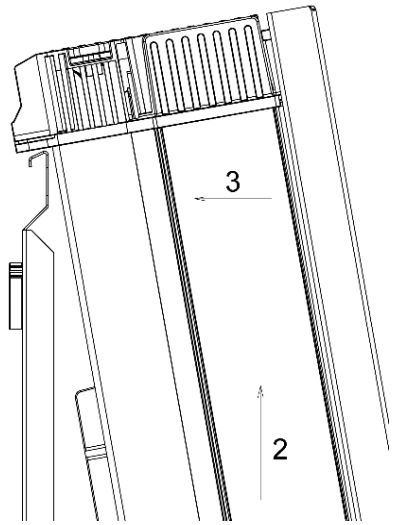


Illustration 2.11 Secure the inverter

Lift the inverter upwards (2) over the top of the mounting plate until the inverter tilts towards the wall (3).

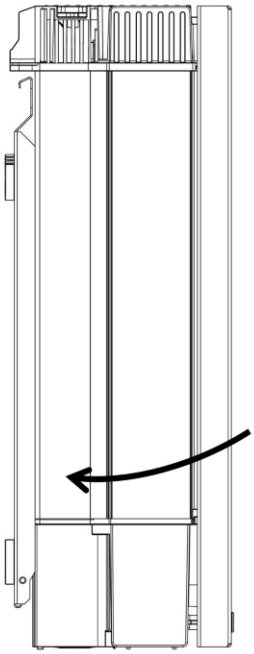


Illustration 2.12 Place Inverter in Mounting Bracket

Place the lower part of the inverter against the mounting bracket.

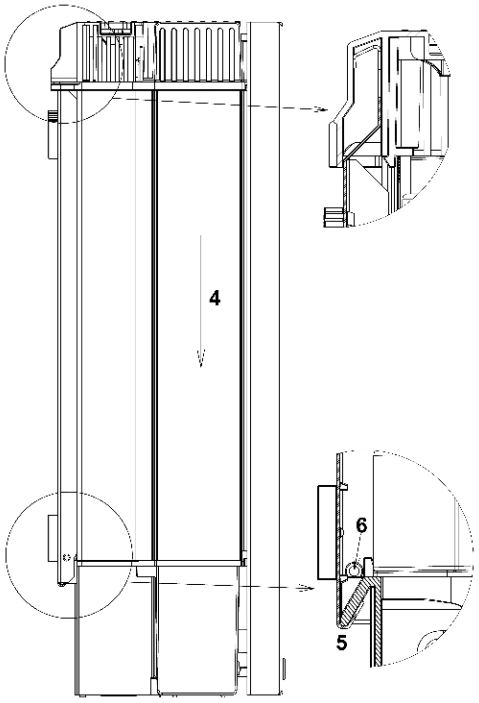


Illustration 2.13 Fasten screws

Lower (4) the inverter and make sure that the hook of the inverter base plate is placed in the lower part of the

mounting bracket (5). Check that it is not possible to lift the bottom of the inverter away from the mounting bracket. (6) Fasten the screws on either side of the wall plate to secure the inverter.

2.3 Removing the Inverter

Loosen the locking screws on either side of the inverter.

Removal is performed in the reverse order of mounting. With a firm grip at the lower end of the inverter, lift the inverter approximately 20 mm vertically. Pull the inverter slightly away from the wall. Push upwards at an angle until the wall plate releases the inverter. Lift the inverter away from the wall plate.

2.4 Opening and Closing the Inverter

⚠WARNING

Remember to observe all ESD safety regulations. Any electrostatic charge must be discharged by touching the earthed housing before handling any electronic component.

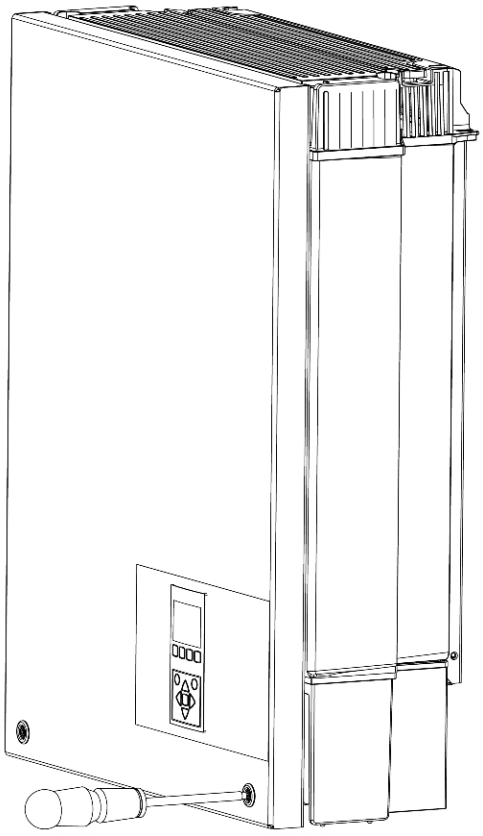


Illustration 2.14 Loosen Front Screws

Use a TX 30 screwdriver to loosen the two front screws. Turn the screwdriver until the screws pop up. Screws are secured with a spring and cannot fall out.

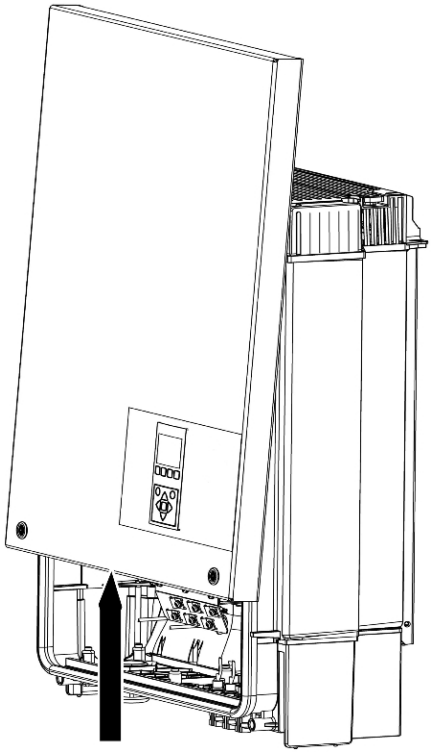


Illustration 2.15 Open the Inverter

Push the front cover upwards. When a slight resistance is felt, give the front cover a tap on the bottom to snap it into holding position. It is recommended to use the holding position instead of dismounting the front cover completely.

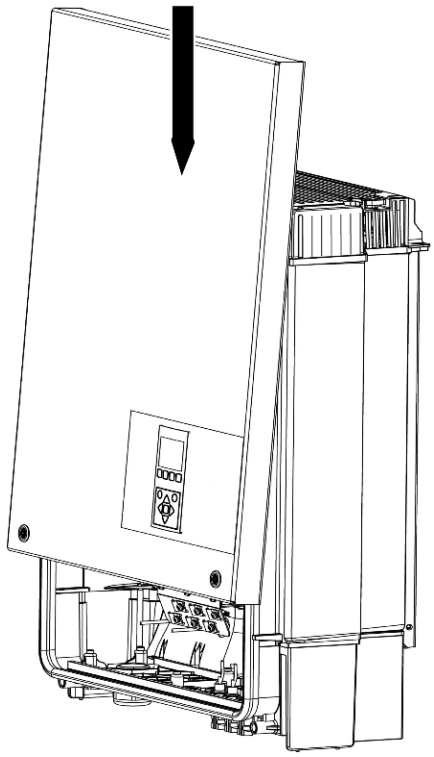


Illustration 2.16 Close the Inverter

To close the inverter, hold on to the lower end of the front cover with one hand and give it a tap on the top until it falls into place. Guide the front cover into place and fasten the two front screws.

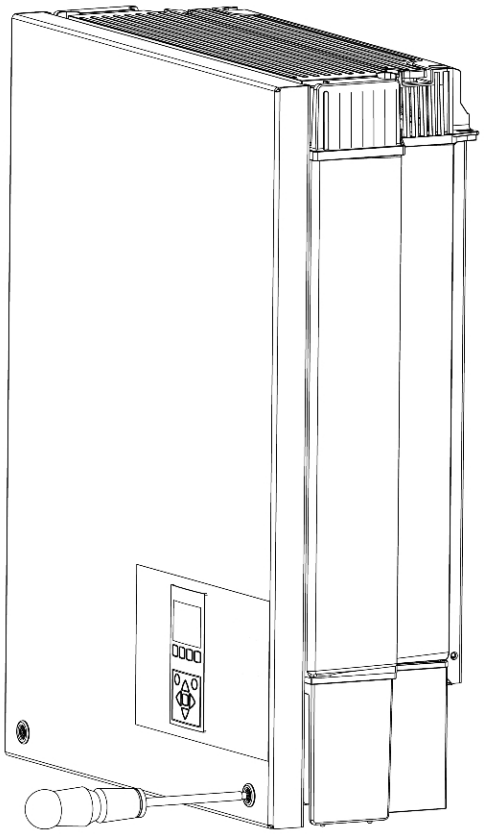


Illustration 2.17 Fasten Front Screws

⚠CAUTION

The two front screws are the PE connection to the front cover. Make sure that both screws are mounted and fastened with the specified torque.

2.5 AC Grid Connection

NOTE

When choosing the installation place, ensure that all labels are visible at all times. For details refer to *4 Technical Data*.

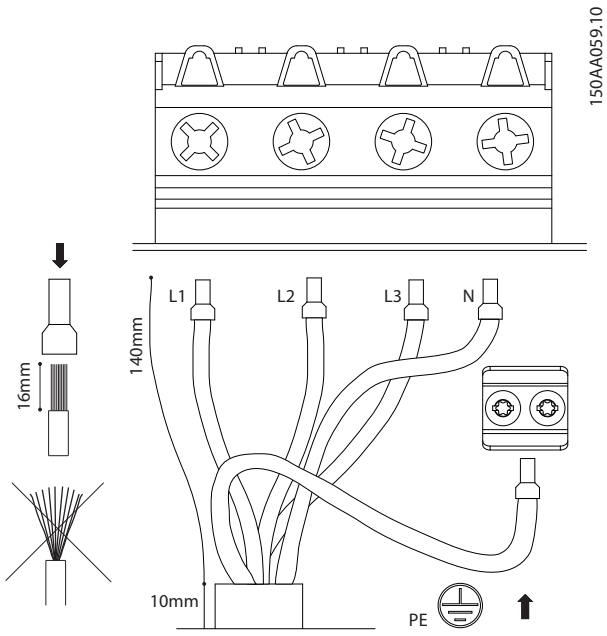


Illustration 2.18 AC Cable Wire Strip

The illustration shows the stripping of insulation of all 5 wires of the AC cable. The length of the PE wire must be longer than the mains and neutral wires.

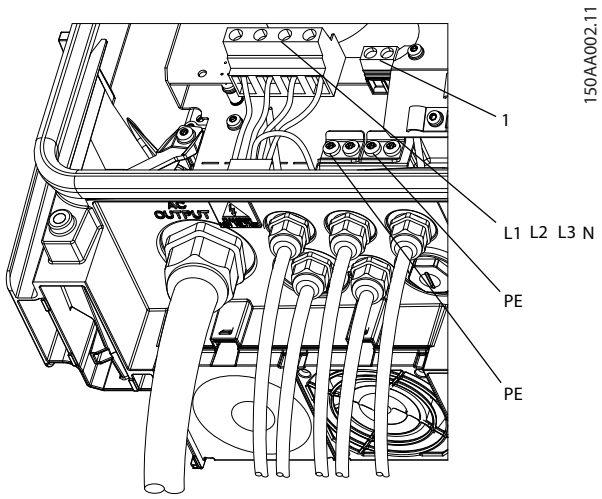


Illustration 2.19 AC Connection Area

1	Short-circuit bridge
L1, L2, L3, N	3 mains (L1, L2, L3) and neutral (N) terminals
PE	Protective earth wire

Table 2.1 Legend to *Illustration 2.19*

1. Verify the inverter matches the grid-voltage.
2. Release main circuit breaker and make precautions to prevent reconnection.
3. Open the front cover.
4. Insert the cable through the AC gland to the terminal blocks.
5. The three mains wires (L1, L2, L3) and the Neutral wire (N) are mandatory and must be connected to the 4-pole terminal block with the respective markings.
6. The Protective Earth wire (PE) is mandatory and must be connected directly to the chassis PE terminal. Insert the wire and fasten the screw to secure the wire.
7. All wires must be properly fastened with the correct torque. See *4.6 Torque Specifications for Installation*.
8. Close the front cover, and remember to verify that both front screws are applied with the correct torque (6-8 Nm) to obtain PE connection.
9. Close main circuit breaker.

CAUTION

For safety, check all wiring. Connecting a phase wire to the neutral terminal may permanently damage the inverter. Do not remove the short-circuit bridge at (1).

2.6 Parallel PV String Configuration

For parallel PV string configuration, always use the internal parallel jumper, together with an external parallel coupling.

2

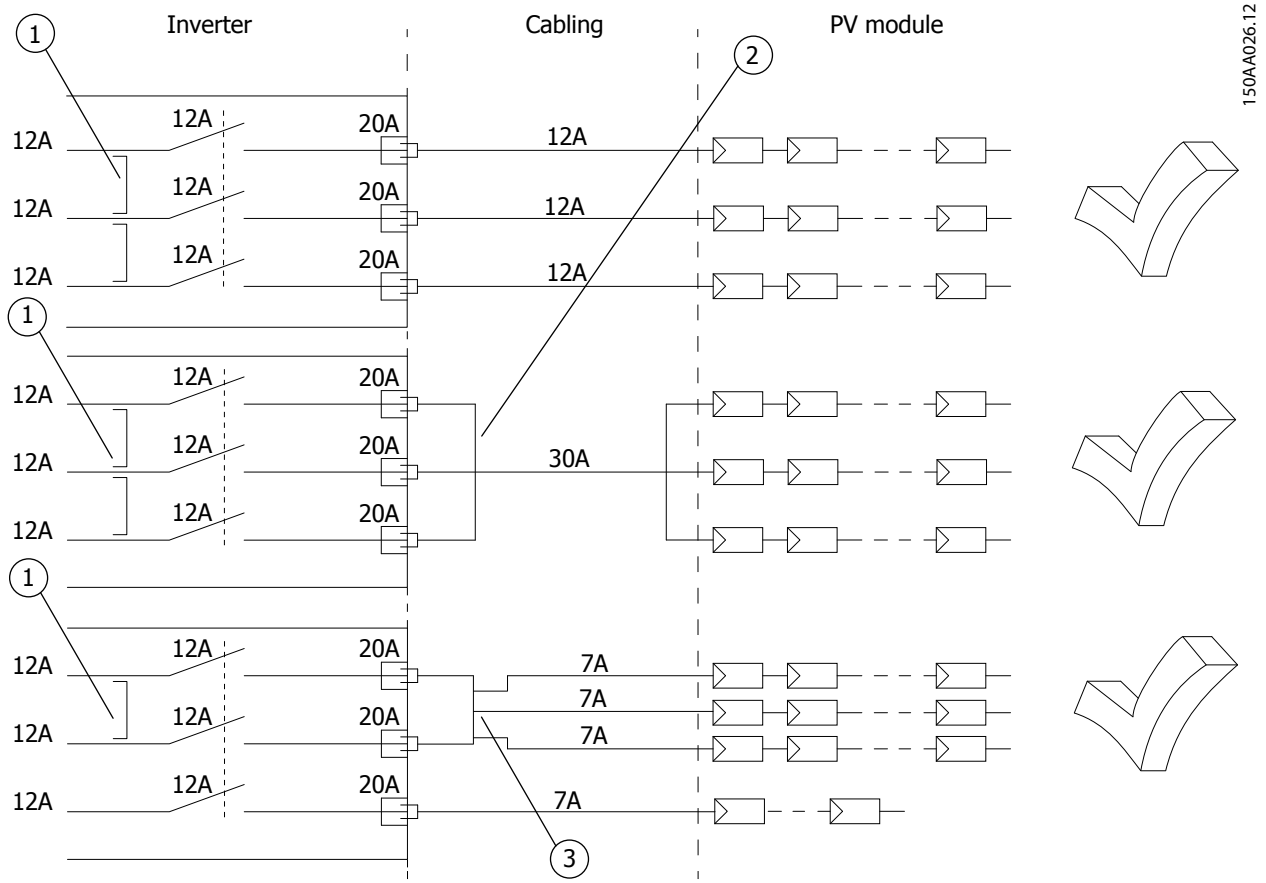


Illustration 2.20 Correct Parallel Connection

1	Parallel jumper
2	Parallel connection, 3 inputs
3	Parallel connection, 2 inputs

Table 2.2 Legend to *Illustration 2.20*

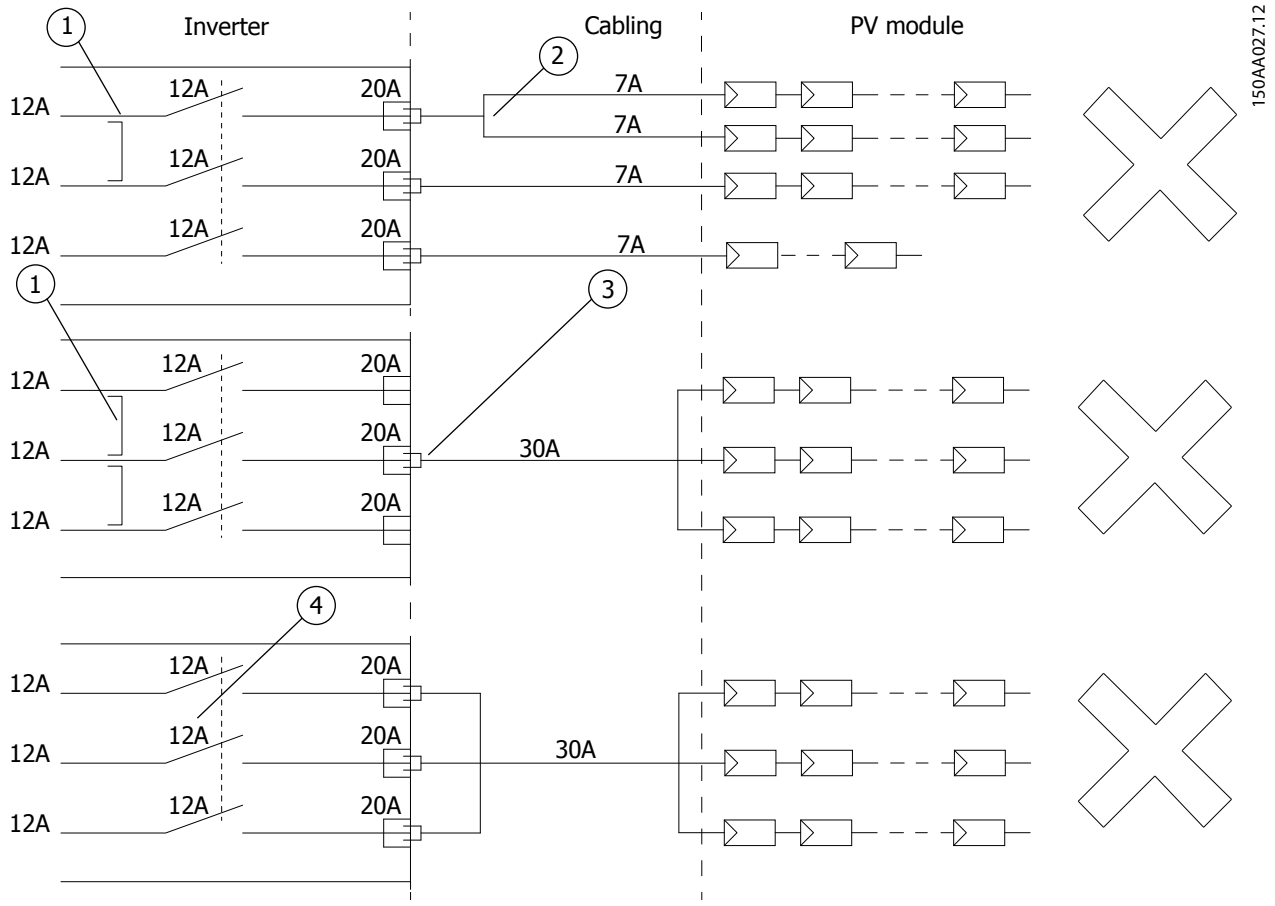


Illustration 2.21 Incorrect Parallel Connection

1	Parallel jumper
2	Parallel connection, 1 input. Current in first input is exceeded, thus overloading cable and PV load switch.
3	Parallel connection missing. All PV power feeds into one input, thus risking overload of PV connector, cable and PV load switch.
4	Parallel jumper missing, thus risking overload of PV connector, cable and PV load switch in the event of inverter failure.

Table 2.3 Legend to *Illustration 2.21*

2

2.7 PV Connection

⚠WARNING

Do NOT connect PV to earth!

NOTE

Use a suitable voltmeter that can measure up to 1000 V DC.

PV Connection Procedure:

1. First verify the polarity and maximum voltage of the PV arrays by measuring the PV open-circuit voltage. The PV open-circuit voltage must not exceed 1000 V DC.
2. Measure the DC voltage between the plus-terminal of the PV array and Earth (or the green/yellow PE cable). The voltage measured should approximate zero. If the voltage is constant and not zero there is an insulation failure somewhere in the PV array. Locate and fix the failure before continuing.
3. Repeat this procedure for all arrays. It is allowed to distribute the input power on the inputs unevenly, presuming that:
   - The nom. PV power of the inverter is not exceeded (6.2 / 8.2 / 10.3 / 12.9 / 15.5 kW).
   - The maximum short-circuit current of the PV modules must not exceed 12 A per input.
4. On the inverter turn the PV load switch into off position. Connect the PV cables by means of MC4 connectors. Ensure correct polarity! The PV load switch can now be switched on when required.

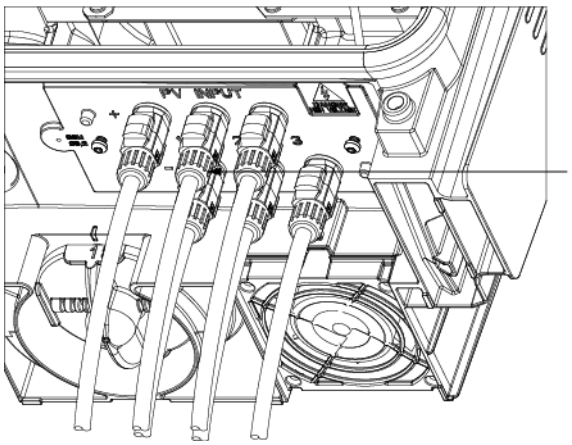


Illustration 2.22 DC Connection Area

⚠CAUTION

When unmated, the MC4 connectors are not IP54. Intrusion of moisture may occur. In situations where the PV connectors are not fitted, a seal cap must be mounted (included in the scope of the delivery). All inverters with MC4 connections are delivered with seal caps on inputs 2 and 3. During installation, the seal caps of those inputs that are to be used are discarded.

NOTE

The inverter is protected against reversed polarity but it will not generate power until the polarity is corrected. To achieve optimum production, the open-circuit voltage (STC) of the PV modules must be lower than the max. input voltage of the inverter (see *4.1 General Data*), multiplied with a factor of 1.13. U_{OC}, STC x 1.13 ≤ U_{MAX}, inv.

2.8 Auxiliary Input/Output

The inverter has the following auxiliary input/output:

- 2 x RJ-45 for RS-485
- 2 x RJ-45 for Ethernet
- 1 x 8 pole terminal block for RS-485
- 1 x 10 pole terminal block for
  - PT1000 temperature sensor input x 3
  - Irradiation sensor input
  - Energy meter (S0) input
- 1 x 2 pole terminal block for relay outputs

Refer to the specifications for an overview of the communication board and to the inverter user manual for details regarding auxiliary input configuration via the display.

2.9 Autotest Procedure

An automatic test of the inverter can be initialised by activating the inverter autotest procedure:

- Via the display, go to [Setup → Autotest] and press OK.
- Via the web interface, go to [Inverter level: Setup → Setup details → Autotest] and click on [Start → Test].

The inverter autotest manual can be downloaded from www.danfoss.com/solar.

3 Start-up and Check of Settings

3.1.1 Initial Setup

The inverter is shipped with a predefined set of settings for different grids. All grid specific limits are stored in the inverter and must be selected at installation. It is always possible to see the applied grid limits in the display. The inverter accounts for daylight saving automatically.
After installation, check all cables and then close the inverter.
Turn on AC at the mains switch.

Follow the setup wizard in the display, or, alternatively, set up the inverter via the web interface.

When prompted by the display select language. This selection has no influence on the operating parameters of the inverter and is not a grid code selection.

Illustration 3.1 Select Language

The language is set to English at initial start-up. To change this setting press the OK button. Press '▼' to scroll down through the languages. Select language by pressing 'OK'.

NOTE

To use the default language (English) simply press the 'OK' button twice to select and accept.

Illustration 3.2 Set Time

Set time as prompted by the display. Press 'OK' to select number. Press '▲' to scroll up through the numbers. Select by pressing 'OK'.
The clock is 24-hour format.

NOTE

It is very important to set the time and date accurately as the inverter uses this for logging. If an incorrect time/date is accidentally set, correct it immediately in the set date and time menu [Setup → Inverter details → Set date and time].

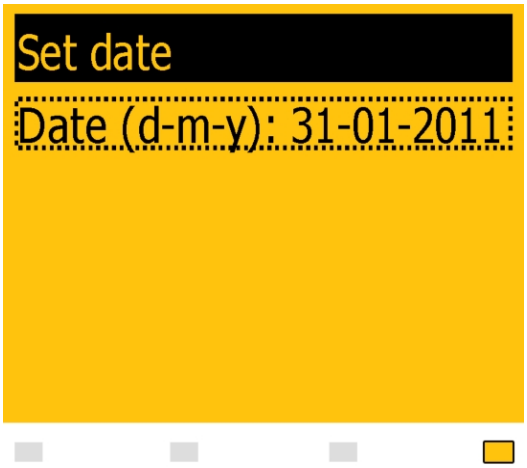


Illustration 3.3 Set Date

Set date as prompted by the display. Press 'OK' to select. Press '▲' to scroll up through the numbers. Select by pressing 'OK'.

3

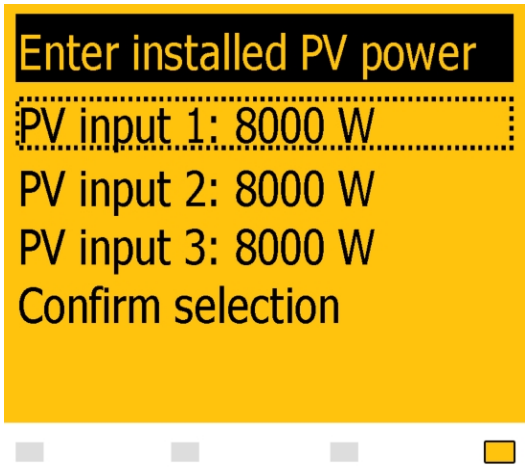


Illustration 3.4 Installed PV Power

Enter the amount of installed PV power for each of the PV inputs. When two or more PV inputs are connected in parallel, each PV input in the parallel group must be set to the total amount of PV power installed to that group divided by the number of parallel inputs. See *Table 3.1*.

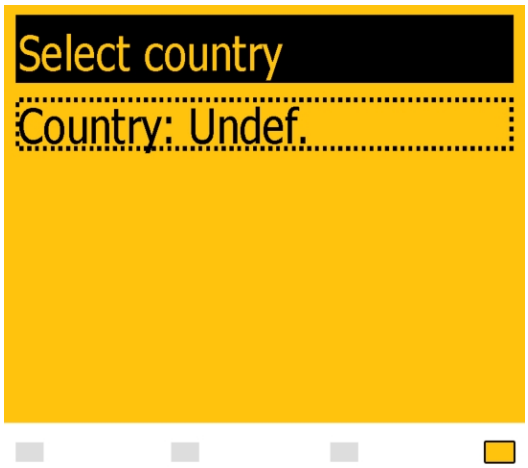


Illustration 3.5 Select Country

Select the country in which the inverter is installed. Press '▼' to scroll down the list of countries. To select a country, press 'OK'.

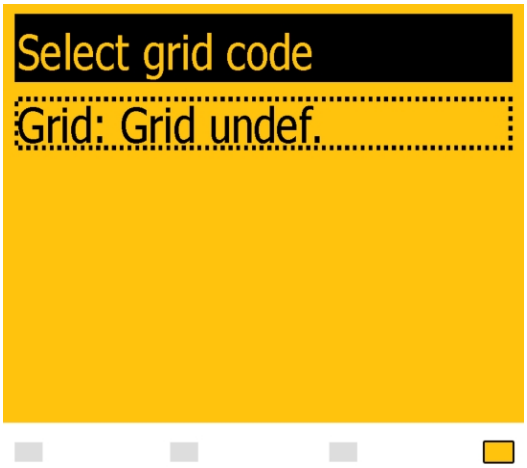


Illustration 3.6 Select Grid Code

The display will now show “Select grid”. The grid code is set to “undefined” at initial start-up. To select grid code, press 'OK'. Press '▼' to scroll down through the list of countries. Select the grid code for the installation by pressing ‘OK’. It is very important that the correct grid code is chosen.

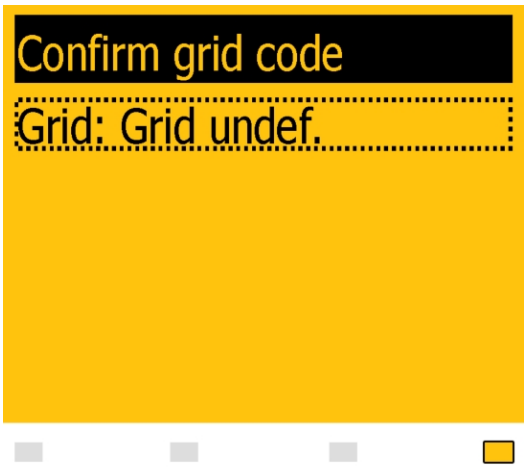


Illustration 3.7 Confirm Grid Code Selection

Confirm the choice by selecting the grid code again and press 'OK'. The settings for the chosen grid code have now been activated.

⚠CAUTION

Correct selection of grid code is essential to comply with local and national standards.

NOTE

If the two grid code selections do not match they will be cancelled and it will be necessary to redo the selections. If an incorrect grid code is accidentally accepted at the first selection, simply accept the "Grid: Undefined" in the confirm grid code screen. This will cancel the country selection and a new selection is possible.

NOTE

If an incorrect grid code is selected twice, call service.

The inverter will start automatically if sufficient solar radiation is available. The start-up will take a few minutes. During this period, the inverter will carry out a self-test.

Actual Configuration	***"Installed PV power"*** to be programmed
PV1, PV2 and PV3 are all set into individual mode. The nominal PV power installed are: PV 1: 6000 W PV 2: 6000 W PV 3: 3000 W	 PV 1: 6000 W PV 2: 6000 W PV 3: 3000 W
PV1 and PV2 are set into parallel mode and have a total of 10 kW PV power installed. PV3 is set into individual mode and has nominal 4 kW PV power.	PV 1: 5000 W PV 2: 5000 W PV 3: 4000 W
PV1 and PV2 are set into parallel mode and have a total of 11 kW PV power installed. PV3 is set to 'Off' and has no PV installed.	PV 1: 5500 W PV 2: 5500 W PV 3: 0 W

Table 3.1 Examples of Installed PV Power

3.2 Troubleshooting

For information on Troubleshooting, see the TLX Reference Manual.

3.3 Master Mode

The TLX Pro and TLX Pro+ inverters include a Master mode feature that allows one inverter to be appointed as master inverter. From the web interface of the master inverter, it is possible to access any inverter in the network from one single point using a standard web browser. The master inverter can act as a datalogger, collecting data from all inverters in the network. These data can be displayed graphically from the web interface of the master inverter, or the data can also be uploaded to external webportals or exported directly to a PC. The master inverter is also able to replicate settings and data to the other TLX Pro and TLX Pro+ inverters in the network, enabling easy commissioning and data management of larger networks.

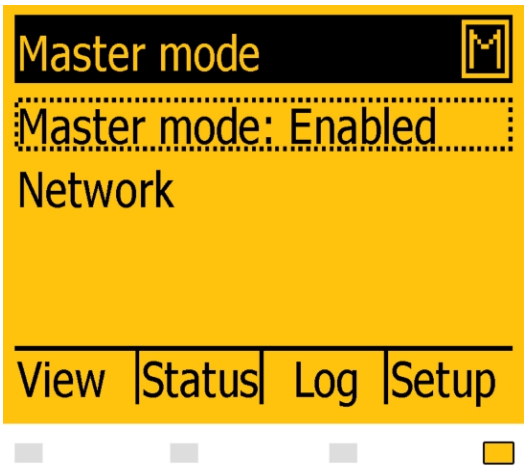


Illustration 3.8 Master Mode

To enable Master mode go to the *Inverter details* menu [Setup→Inverter details→Master mode] and set Master mode to *Enabled.* Ensure that no other master inverters are present in the network prior to carrying out this action. When Master mode is enabled, it is possible to initiate a network scan [Setup→Inverter details→Master mode→Network]. This will show all inverters connected to the master inverter.

NOTE

Only 1 master per network is possible.

NOTE

The master inverter can operate in a network of up to 99 follower inverters.

CAUTION

All inverters connected to the internet through Ethernet must be behind a firewall.

CAUTION

At first login to the web ,server change the default password. Plant level: [Setup → Web server → Admin].

4 Technical Data

4.1 General Data

Nomenclature[1)]	Parameter	TLX Series 6k	TLX Series 8k	TLX Series 10k	TLX Series 12.5k	TLX Series 15k
	AC					
|S|	Rated apparent power	6000 VA	8000 VA	10000 VA	12500 VA	15000 VA
$P_{ac,r}$	Rated active power[*)]	6000 W	8000 W	10000 W	12500 W	15000 W
	Active power at cos(phi) = 0.95[**)]	5700 W	7600 W	9500 W	11875 W	14370 W
	Active power at cos(phi) = 0.90[**)]	5400 W	7200 W	9000 W	11250 W	13500 W
	Reactive power range	0-3.6 kVAr	0-4.8 kVAr	0-6.0 kVAr	0-7.5 kVAr	0-9.0 kVAr
$V_{ac,r}$	Rated grid voltage (range)	3P + N + PE - 230 V / 400 V (± 20%)				
	Rated current AC	3 x 8.7 A	3 x 11.6 A	3 x 14.5 A	3 x 18.1 A	3 x 21.7 A
I_{acmax}	Max. current AC	3 x 9.0 A	3 x 11.9 A	3 x 14.9 A	3 x 18.7 A	3 x 22.4 A
	AC current distortion (THD %)	< 4%		< 5%		
$cosphi_{ac,r}$	Power factor at 100% load	> 0.99				
	Controlled power factor range	0.8 over-excited 0.8 under-excited				
	Power loss, *Connecting mode*	10 W				
	Night-time power loss (off grid)	< 5 W				
f_r	Grid frequency (range)	50 Hz (± 5 Hz)				
	DC					
$P_{mpptmax}$	Maximum PV input power per MPPT	8000 W				
$\Sigma P_{mpptmax}$	Max./nom. converted PV input power, total	6200 W	8250 W	10300 W	12900 W	15500 W
$V_{dc,r}$	Nominal rated voltage DC	700 V				
V_{mppmin} - V_{mppmax}	MPP voltage - nominal power [2)]	260-800 V	345-800 V	430-800 V	358-800 V	430-800 V
	MPP efficiency, static	99.9%				
	MPP efficiency, dynamic	99.7%				
V_{dcmax}	Max. DC voltage	1000 V				
$V_{dcstart}$	Turn on voltage DC	250 V				
V_{dcmin}	Turn off voltage DC	250 V				
I_{dcmax}	Max. current DC	2 x 12 A			3 x 12 A	
	Max. short circuit current DC at STC	2 x 12 A			3 x 12 A	
	Min. on grid power	20 W				
	Efficiency					
	Max. efficiency	97.8%	97.9%	98.0%		

Nomenclature[1)]	Parameter	TLX Series 6k	TLX Series 8k	TLX Series 10k	TLX Series 12.5k	TLX Series 15k
	Euro efficiency, V at $_{dc,r}$	96.5%	97.0%	97.0%	97.3%	97.4%
	Other					
	Dimensions (H,W,D)	700 x 525 x 250 mm				
	Mounting	Wall bracket				
	Weight	35 kg				
	Acoustic noise level	56 dB(A)				
	MPP trackers	2			3	
	Operation temperature range	-25..60 °C				
	Nom. temperature range	-25..45 °C				
	Storage temperature	-25..60 °C				
	Overload operation	Change of operating point				
	Active power control[3)]	Included				
	Reactive power control	TLX+ and TLX Pro+				

Table 4.1 General Specifications

1) According to FprEN 50524 where relevant.

2) At identical input voltages. At unequal input voltages, V_{mppmin} can be as low as 250 V depending on total input power.

3) Remotely controlled via CLX monitoring and grid management product or third-party device.

**) At rated grid voltage ($V_{ac,r}$), Cos(phi) = 1.*

***) At rated grid voltage ($V_{ac,r}$).*

Parameter	TLX Series	
Functional Safety	**Passive**	**Active AC disconnection**
Safety (protective class)	Class I	
PELV on the communication and control card	Class II	
Islanding detection - loss of mains		Three-phase monitoring ROCOF
Voltage magnitude		Included
Frequency		Included
Insulation resistance		Included
RCMU - Type B		Included
Indirect contact protection	Yes (class I, grounded)	

Table 4.2 Functional Safety Specifications

4.2 Norms and Standards

Normative References	TLX Series				
	6k	8k	10k	12.5k	15k
Directive LVD	2006/95/EC				
Directive EMC	2004/108/EC				
Safety	IEC 62109-1/IEC 62109-2				
Integrated PV load switch	VDE 0100-712				
EMC immunity	EN 61000-6-1				
	EN 61000-6-2				
EMC emission	EN 61000-6-3				
	EN 61000-6-4				
Utility interference	EN 61000-3-2/-3			EN 61000-3-11/-12	
CE	Yes				
Utility characteristics	IEC 61727				
	EN 50160				
S0 Energy Meter	EN62053-31 Annex D				
Functional Safety	**For transformerless inverter**				
Germany	VDE 0126-1-1/A1[1)]				
	VDE AR-N 4105 (August 2011)[2)]				
Greece	Technical requirements for the connection of independent generation to the grid, Public Power Corporation (PPC).				
Italy	-	CEI 0-21:2012-06, Terna Guida Tecnica Allegato A.70[2)]			
Spain	RD1699 (2011)				
	RD661 (2007)				
Portugal	VDE 0126-1-1, ISO/IEC Guide 67: 2004 - System No.5				
UK	-	G59/2-1, G83/1-1		G59/2-1	
Ancillary Services	**TLX Series**				
	TLX+ and TLX Pro+				
	6k	**8k**	**10k**	**12.5k**	**15k**
Austria	TOR – Hauptabschnitt D4, TOR – Hauptabschnitt D2				
Belgium	Synergrid C10/11 – Revisie 2012-06, Synergrid C10/17- revisie 8 mei 2009				
Czech Republic	Czech Energy Act (Act No. 458/2000), Article 24, Paragraph 10 part I,II,III rev09 2009				
France	UTE NF C 15-712-1 (UNION TECHNIQUE DE L'ELECTRICITE, GUIDE PRATIQUE, Installations photovoltaïques raccordées au réseau public de distribution). NF C 15-100 (Installations électriques à basse tension). Journal Officiel, Décret n°2008-386 du 23 avril 2008 relatif aux prescriptions techniques générales de conception et de fonctionnement pour le raccordement d'installations de production aux réseaux publics d'électricité.				
Germany	-	BDEW- Technische Richtlinie Erzeugungsanlagen am Mittelspannungsnetz Ausgabe, Juni 2008 und Ergänzungen von 01/2009, 07/2010, 02/2011[2)]			
Spain	REE BOE núm. 254				

Table 4.3 Norms and Standards

1) Deviant from VDE 0126-1-1 section 4.7.1, the isolation resistance measurement limit is set to 200 kΩ, in accordance with authorities.

2) TLX+ and TLX Pro+ only.

4.3 France UTE Requirements

NOTE

In France, observe the UTE C 15-712-1 and NF C 15-100 requirements.

For installation in France, apply warning label to front of inverter.

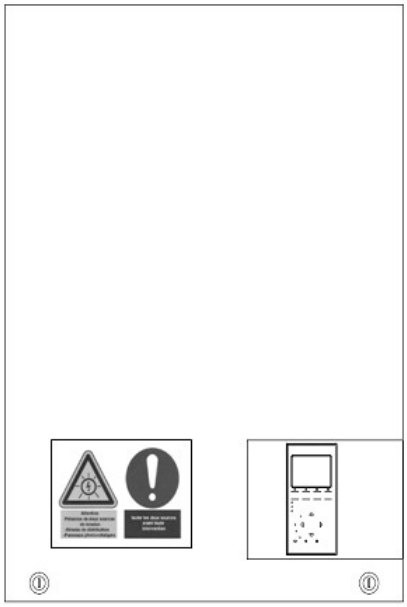


Illustration 4.1 Position of Warning Label

Parameter	Condition	Specification
Wall Plate	Hole diameter	30 x 9 mm
	Alignment	Perpendicular ± 5° all angles

Table 4.5 Wall Plate Specifications

4.4 Installation

Parameter	Specification
Temperature	−25 °C - +60 °C (>45 °C derating)
Environmental class according to IEC	IEC60721-3-3 3K6/3B3/3S3/3M2
Air quality - general	ISA S71.04-1985 Level G2 (at 75% RH)
Air quality - coastal, heavy industrial and agricultural zones	Must be measured and classified acc. to ISA S71.04-1985
Vibration	1G
Ingress protection class	54
Max. operating altitude	3000 m above sea level. PELV protection is effective up to 2000 m above sea level only.
Installation	Avoid constant stream of water. Avoid direct sunlight. Ensure adequate air flow. Mount on non-flammable surface. Mount upright on vertical surface. Prevent dust and ammonia gases.

Table 4.4 Conditions for Installation

4.5 Cable Requirements

Cable	Condition	Specification
AC	**5 wire cable**	**Copper**
Outer diameter		18-25 mm
Max. recommended cable length TLX Series 6k, 8k and 10k	2.5 mm^2	21 m
	4 mm^2	34 m
	6 mm^2	52 m
	10 mm^2	87 m
Max. recommended cable length TLX Series 12.5k	4 mm^2	28 m
	6 mm^2	41 m
	10 mm^2	69 m
Max. recommended cable length TLX Series 15k	6 mm^2	34 m
	10 mm^2	59 m
DC		**Max. 1000 V, 12 A**
Cable length	4 mm^2 - 4.8 Ω /km	< 200 m*
Cable length	6 mm^2 - 3.4 Ω /km	>200-300 m*
Mating connector	Multi-contact	PV-ADSP4./PV-ADBP4.
* The distance between inverter and PV array and back, plus the cumulative length of PV array cabling.		

Table 4.6 Cable Requirements

NOTE

Avoid power loss in cables greater than 1% of nominal inverter rating.

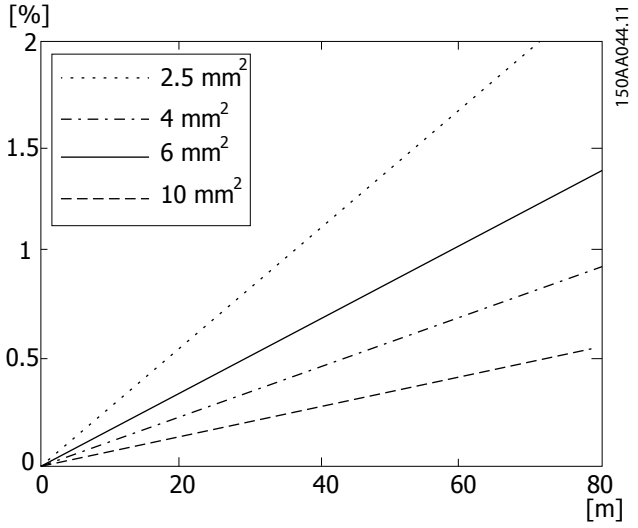


Illustration 4.2 TLX Series 6k Cable Losses [%] versus Cable Length [m]

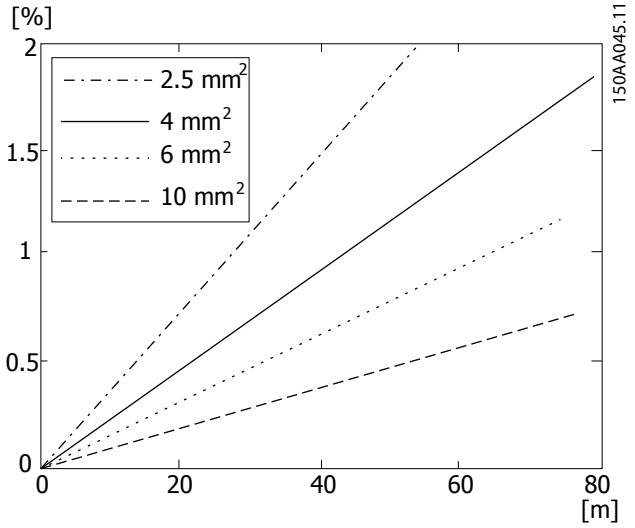


Illustration 4.3 TLX Series 8k Cable Losses [%] versus Cable Length [m]

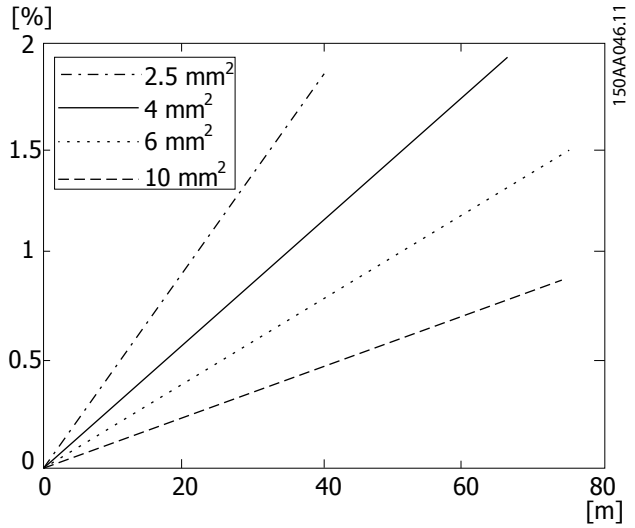


Illustration 4.4 TLX Series 10k Cable Losses [%] versus Cable Length [m]

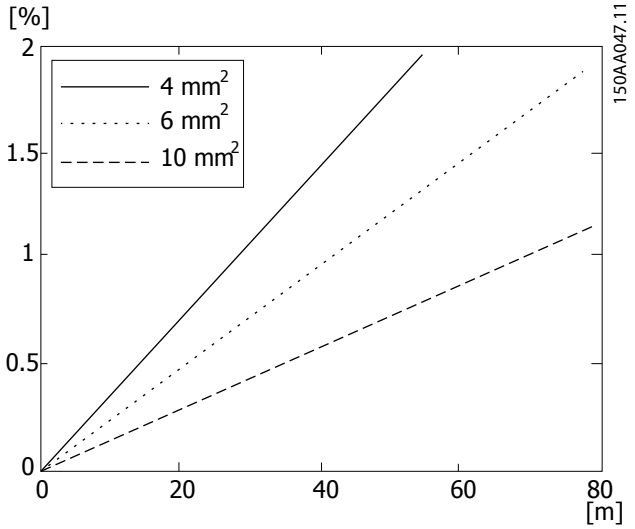


Illustration 4.5 TLX Series 12.5k Cable Losses [%] versus Cable Length [m]

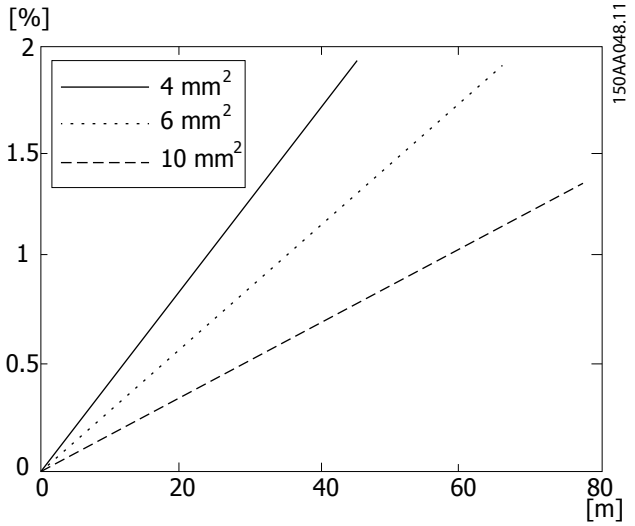


Illustration 4.6 TLX Series 15k Cable Losses [%] versus Cable Length [m]

Consider also the following when choosing cable type and cross-sectional area:

- Ambient temperature
- Layout type (inside wall, under ground, free air etc.)
- UV resistance

4.6 Torque Specifications for Installation

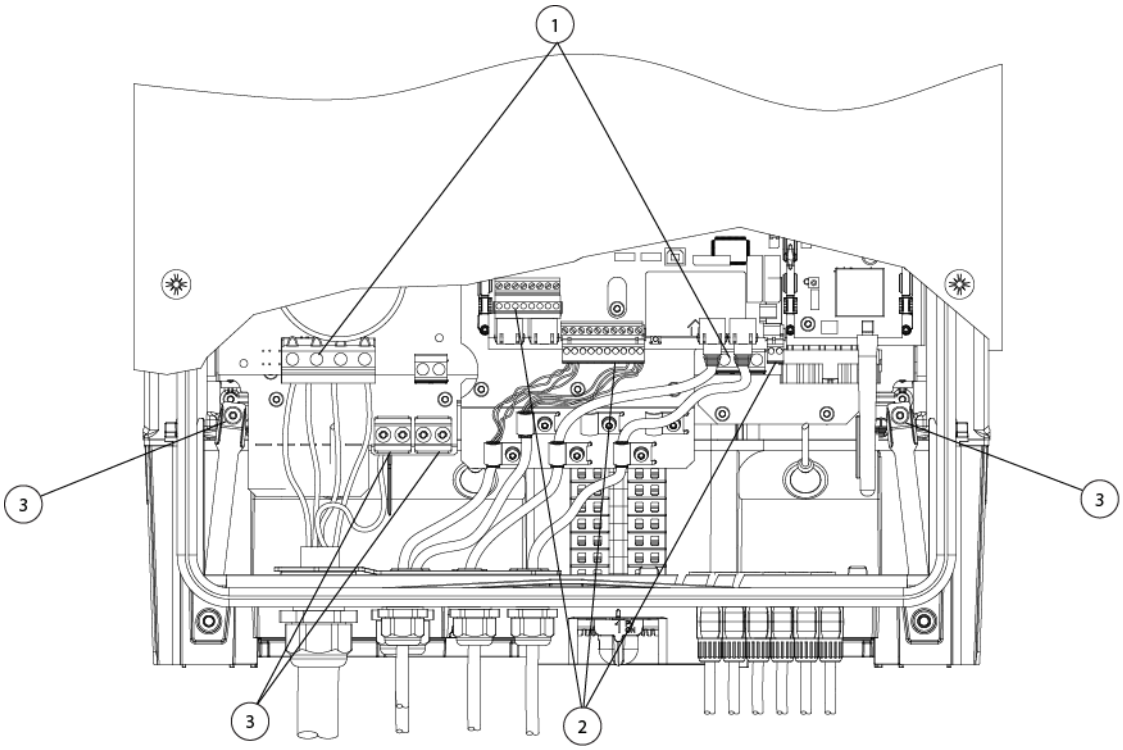


Illustration 4.7 Overview of Inverter with Torque Indications, 1-3

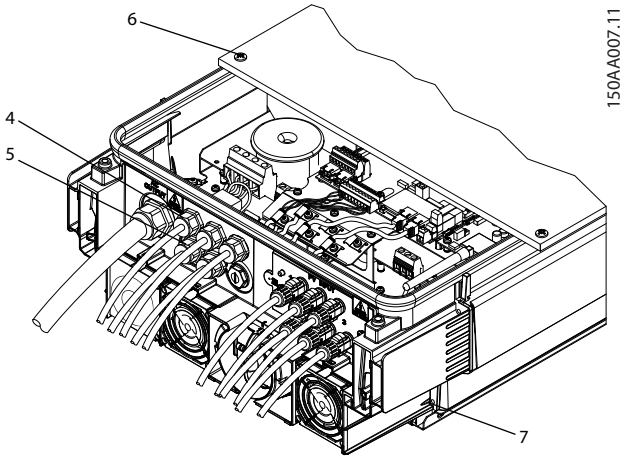


Illustration 4.8 Overview of Inverter with Torque Indications, 4-7

	Parameter	Tool	Tightening Torque
1	Terminal blocks (large)	Straight slot 1.0 x 5.5 mm	Min. 1.2 Nm
2	Terminal blocks (small)	Straight slot 1.0 x 5.5 mm	0.5 Nm
3	PE	Straight slot 1.0 x 5.5 mm	2.2 Nm
4	M16	SW 19 mm	2-3 Nm
5	M25	SW 30 mm	2-3 Nm
6	Front screw	TX 30	6-8 Nm
7	Locking screw	TX 30	5 Nm

Table 4.7 Legend to *Illustration 4.7* and *Illustration 4.8*, Nm Specifications

4.7 Mains Circuit Specifications

	TLX Series				
	6k	8k	10k	12.5k	15k
Maximum inverter current, $I_{acmax.}$	9.0 A	11.9 A	14.9 A	18.7 A	22.4 A
Recommended blow fuse type gL/gG	13 A	16 A	20 A	20 A	25 A
Recommended automatic fuse type B	16 A	20 A	20 A	25 A	32 A

Table 4.8 Mains Circuit Specifications

4.8 Auxiliary Interface Specifications

Parameter	Parameter Details	Specification
Serial Communication		**RS-485**
Common cable specification	Cable jacket diameter (⌀)	2 x 5-7 mm
	Cable type	Shielded Twisted Pair (STP) (Cat 5e)[2]
	Cable Characteristic Impedance	100 Ω – 120 Ω
	Max. cable length	1000 m
RJ-45 (2 pcs.) connectors	Wire gauge	24-26 AWG (depending on mating metallic RJ-45 plug)
	Cable shield termination	Via metallic RJ-45 plug
Terminal block	Maximum wire gauge	2.5 mm^2
	Cable shield termination	Via EMC cable clamp
Max. number of inverter nodes		63[4]
Galvanic interface insulation		Yes, 500 Vrms
Direct contact protection	Double/Reinforced insulation	Yes
Short-circuit protection		Yes
Communication	Star and daisy chain	**Ethernet**
Common cable	Max. cable length between inverters	100 m (total network length: unlimited)
Specification	Max. number of inverters	100[1]
	Cable type	Shielded Twisted Pair (STP) (Cat 5e)[2]
Temperature sensor input		**3 x PT1000** [3]
Cable specification	Cable jacket diameter (⌀)	4-8 mm
	Cable type	Shielded Single Pair - 2-wire
	Cable shield termination	Via EMC cable clamp
	Maximum wire gauge	2.5 mm^2
	Maximum resistance per wire	10 Ω
	Maximum cable length	30 m
Sensor specification	Nominal resistance/temperature coefficient	3.85 Ω/°C
	Measurement range	-20 °C - +100 °C
	Measurement accuracy	±3%
Direct contact protection	Double/Reinforced insulation	Yes
Short-circuit protection		Yes
Irradiation sensor input		**x 1**
Cable specification	Cable jacket diameter (⌀)	4-8 mm
	Cable type	Shielded Single Pair - Number of wires depend on the sensor type used
	Cable shield termination	Via EMC cable clamp
	Maximum wire gauge	2.5 mm^2
	Maximum resistance per wire	10 Ω
	Maximum cable length	30 m
Sensor Specification	Sensor type	Passive
	Measurement accuracy	±5% (150 mV sensor output voltage)
	Output voltage of sensor	0-150 mV
	Max. output impedance (sensor)	500 Ω
	Input impedance (electronics)	22 kΩ
Direct contact protection	Double/Reinforced insulation	Yes
Short-circuit protection		Yes
Energy meter input	**S0 input**	**x 1**

Parameter	Parameter Details	Specification
Cable specification	Cable jacket diameter (⌀)	4-8 mm
	Cable type	Shielded Single Pair - 2-wire
	Cable shield termination	Via EMC cable clamp
	Maximum wire gauge	2.5 mm^2
	Maximum cable length	30 m
Sensor Input Specification	Sensor input class	Class A
	Nominal output current	12 mA for an 800 Ω load
	Maximum short-circuit output current	24.5 mA
	Open-circuit output voltage	+12 VDC
	Maximum pulse frequency	16.7 Hz
Direct contact protection	Double/Reinforced insulation	Yes
Short-circuit protection		Yes

Table 4.9 Auxiliary Interface Specifications

[1] A maximum of 100 inverters can be connected in 1 network. If GSM modem is used for portal upload, the number of inverters in a network is limited to 50.

[2] For underground use, outdoor burial type cable is recommended for both Ethernet and RS-485.

[3] Third input is used for compensation of the irradiation sensor.

[4] The number of inverters to be connected in the RS-485 network depends on which peripheral device is connected.

⚠CAUTION

To ensure fulfilment of IP enclosure rating, correctly mounted cable glands are essential for all peripheral cables.

⚠CAUTION

To ensure EMC compliance, shielded cables must be applied for sensor inputs and RS-485 communication. Unshielded cables may be applied for alarm outputs. Other auxiliary cables must pass through the designated EMC cable clamps to establish mechanical fixing and in case of shielded cable termination to the shielding device.

Parameter	Condition	Specification
Potential free contact	Relay output	x 1
Rating AC		250 V AC, 6.4 A, 1600 W
Rating DC		24 V DC, 6.4 A, 153 W
Maximum wire gauge		2.5 mm^2
Overvoltage category		Class III
Modem		GSM

Table 4.10 Auxiliary Input Specifications

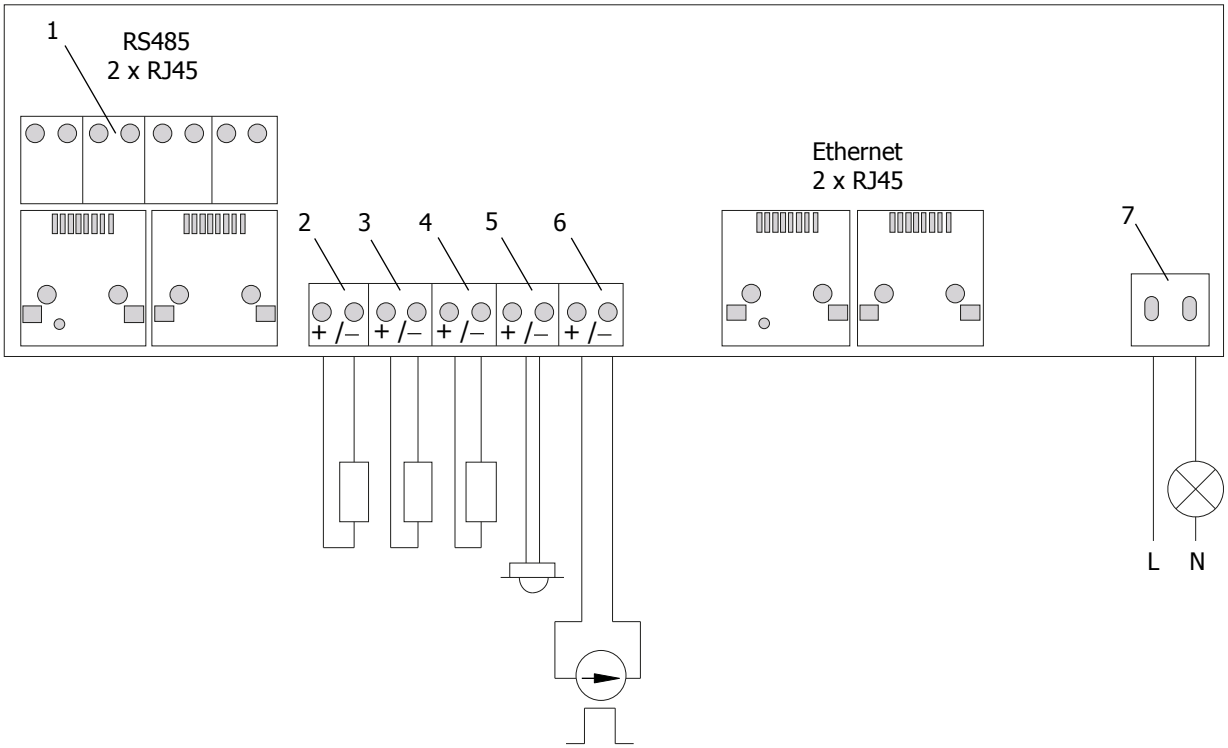


Illustration 4.9 Communication Board

1	8-pole terminal blocks
2	PT1000/module temp.
3	PT1000/ambient temp.
4	PT1000/irradiation sensor temp.
5	Irradiation sensor
6	S0/Energy meter
7	Relay 1

Table 4.11 Legend to *Illustration 4.9*

4.9 RS-485 and Ethernet Connections

RS-485

Terminate the RS-485 communication bus at both ends.
To terminate the RS-485 bus:

- Connect Bias H to RX/TX B
- Connect Bias L to RX/TX A

The RS-485 address of the inverter is unique, and defined at the factory.

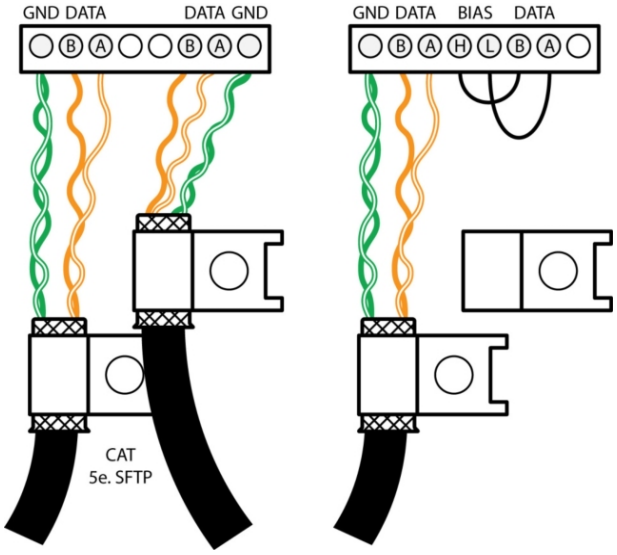


Illustration 4.10 RS-485 Communication Detail - Cat 5 T-568A

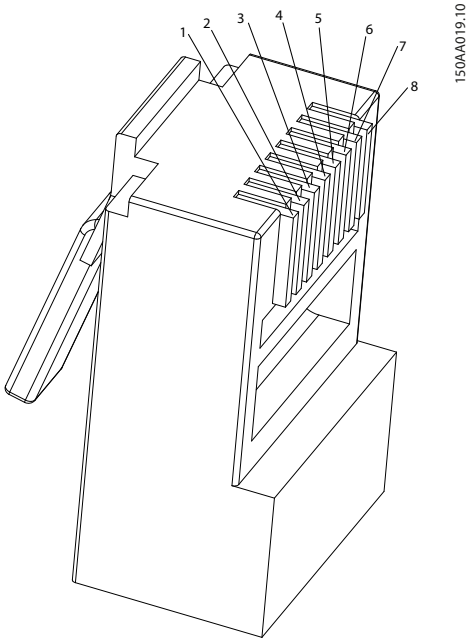


Illustration 4.11 RJ-45 Pinout Detail for RS-485

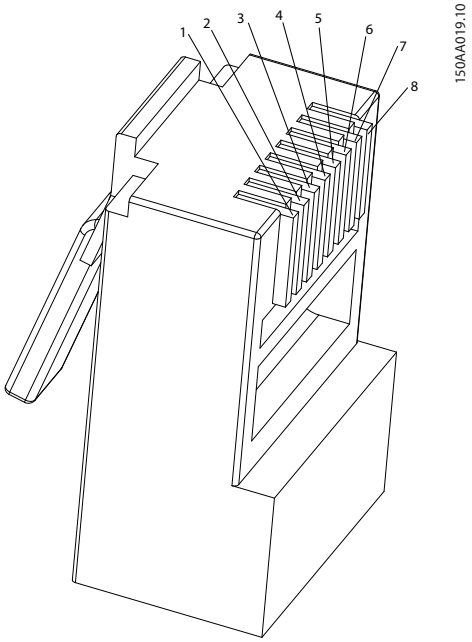


Illustration 4.12 RJ-45 Pinout Detail for Ethernet

1	**GND**
2	GND
3	**RX/TX A (-)**
4	BIAS L
5	BIAS H
6	**RX/TX B (+)**
7	Not connected
8	Not connected

Table 4.12 Legend to *Illustration 4.11*

Bold*=Compulsory, Cat5 cable contains all 8 wires*
For Ethernet: 10Base-TX and 100Base-TX auto cross over

Ethernet

Ethernet connection is available for TLX Pro and TLX Pro+ variants only.

	Colour Standard		
	Pinout Ethernet	**Cat 5 T-568A**	**Cat 5 T-568B**
1	RX+	Green/white	Orange/white
2	RX	Green	Orange
3	TX+	Orange/white	Green/white
4		Blue	Blue
5		Blue/white	Blue/white
6	TX-	Orange	Green
7		Brown/white	Brown/white
8		Brown	Brown

Table 4.13 Legend to *Illustration 4.12*

CAUTION

TLX Pro and TLX Pro+ inverters connected to the internet through Ethernet must be behind a firewall.

CAUTION

At first login to the web server, change the default password. Plant level: [Setup → Web server → Admin].

Danfoss Solar Inverters A/S
Ulsnaes 1
DK-6300 Graasten
Denmark
Tel: +45 7488 1300
Fax: +45 7488 1301
E-mail: solar-inverters@danfoss.com
www.danfoss.com/solar

Danfoss can accept no responsibility for possible errors in catalogues, brochures and other printed material. Danfoss reserves the right to alter its products without notice. This also applies to products already on order provided that such alterations can be made without subsequential changes being necessary in specifications already agreed.
All trademarks in this material are property of the respective companies. Danfoss and the Danfoss logotype are trademarks of Danfoss A/S. All rights reserved.

Rev. date 2012-11-25 Lit. No. L00410309-09_02